

A Summary and Commentary on D. and S. Premack's *Original Intelligence**

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SUMMARY

Some evolutionary cognitive and developmental psychologists propose that the human mind consists of domain-specific modules. These are characterized as self-contained "mini-computers" that process information of a certain kind. Although, according to my reading, much of the extant human brain research does not necessarily support the module view (Greenwald, 1997), still module theories continue to occupy center stage in cognitive developmental and comparative psychology. One would think that neuroscience, as a study of the behavior beneath the skin, would simply replace cognitive psychology. But, perhaps I missed the value of the psychological construct.

In their book, the Premacks set out to provide a synthesis of evidence from various fields in order to identify what they characterize as "original intelligence." Their synthesis is derived from their reading of findings in comparative psychology, developmental psychology, neuroscience, anthropology and other "life sciences." All of the evidence and theory from psychology from which they draw their evidence comes from the cognitive perspective including their own contributions to that research. For them, original intelligence includes certain phylogenetic and ontogenetic contributions that they identify as *expectancies*, capabilities that are present or not present in certain species including humans. These capabilities include inherited expectancies, derived

from natural selection; and expectancies derived from experience and its interaction with inherited expectancies.

Infants have inherited expectancies not only about how physical bodies "act," but also about psychological and biological objects, about language, number, spatial navigation, and music. Indeed, infants have inherited expectancies in all the domains into which human problem solving can be divided. These expectancies are an integral part of the infant's modules. (p. 17)

The authors define modules as "innate devices that guide the infant's learning in all domains that are basic to human knowledge" (p.18). However, they point out that not all learning is "domain specific"; some is domain generic, i.e. not tied to specific modules. The domain specific modules include the physical, psychological, biological, number, space, and music modules. They argue that these are separate capabilities and that some are uniquely human. They draw on evidence from anthropology, brain research, and cognitive developmental and comparative psychology, not surprisingly, excluding research in behavior analysis and behavioral biology.

The book is divided into 10 chapters that describe these capabilities and a conclusion chapter. Chapters 2-5 consider imitation, pedagogy, the sentence, and the word. Imitation, language, and pedagogy are seen as fundamental to the evolution of competencies. These three are present in other species as well as humans to varying degrees. Chapter 6 introduces *belief* or *conviction* as a uniquely human social competency, and not an inherited one. Chapter 7 introduces "theory of mind," which, although present in rudimentary form in chimpanzees is the "cornerstone of an elaborate human social competence" (p.13).

"Departing from the social side" in Chapter 9, they introduce causal reasoning, and in Chapter 10 they introduce equivalence (we might describe this as one type of arbitrarily

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applicable relation or higher order operant). Causal reasoning and analogy are described as complimentary, as they are involved jointly in what I interpreted as the need to know (a kind of capacity for acquiring conditioned establishing operations). In the conclusion chapter they describe cultural factors that change humans that are not induced by accident but instead are accomplished “deliberately.” They argue that humans can “knowingly” change themselves, but more importantly they can change their offspring through educational efforts. Humans can do this, the authors say, because they understand their minds or their competencies and this understanding or perspective provides humans with a unique and historically unprecedented species capability. The cultural process in which this is done seems to be the process of education, a uniquely human interest in improving the prognosis for the next generation. Behavior analysts might argue that formal education is a function of cultural selection that builds on behavioral selection, much of which is made possible by verbal behavior.

COMMENTARY

On the jacket of the book Noam Chomsky states, “The Premacks provide a lucid and carefully argued conception of a theory of mind, based on highly informative research in recent years in developmental and comparative psychology, not the least their own fascinating work.” Why should a book touted by the individual most responsible for a damning effect on *Verbal Behavior* (Skinner, 1957) be of interest to verbal behavior analysts? But, since Chomsky didn’t know what verbal behavior was about, I presumed he might have missed what this book was about too, so I didn’t let his advert put me off. I plunged on because I thought that with a little or a lot of translation there might be points of interest to behavior analysts involved in building verbal operants and higher-order operants in children who are missing them. After all, David Premack did provide behavior analysis with important evidence in the early stages of his career.

I discovered that many of the capabilities identified in developmental and comparative psychology cited by the authors have been identified from a different perspective in research on verbal behavior. For example, the

authors distinguish between “perceptual” and “analogical” functioning. We might describe the former as functions or behavioral outcomes that result from direct-acting contingencies (i.e., contingency-shaped behavior) and the latter as outcomes that result from indirect-acting contingencies (i.e., verbally governed and verbally governing behavior). The latter has been treated extensively in the research on contingency-shaped and verbally governed and verbally governing behavior, in research associated with relational frame theory, and in verbal behavior analysis. More interestingly, verbal behavior analysis findings suggest environmental roots for some of these. On the other hand, some of the capabilities described by the Premacks have not been investigated by behavior analysts and need to be.

How the Book Could Have Benefited from Incorporating Behavior Analysis

One of the contributions of behavior analysis that would have aided the author’s synthesis effort is the phenomenon of *naming* identified by Horne and Lowe (1996); and by Lowe, Horne, Harris, and Randle, (2002). Naming is a major capability that provides the means for children to acquire speaker and listener vocabulary incidentally, and it is one of the two types of speaker-as-own-listener behavior identified in the empirical literature. We now have evidence that naming can be acquired from exemplar experiences when the capability is missing (Fiorile & Greer, 2005; Gillic, 2005; Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005). Clearly, this is work that any synthesis of evidence should no longer omit, because it realigns work in several of what the Premacks identify as the life sciences. While some of this latter evidence was unavailable at the time the authors wrote their book, they appear unaware of the foundational work in behavior analysis that predated their publication. There is a single reference to Skinner (1935), and that article predates Skinner’s (1938) *The Behavior of Organisms* and the post 1945 dramatic change in his epistemology that led to the fundamental distinctions that provided the science of behavior with unique contributions to the life sciences (Moxley, 2004). In *Verbal Behavior*, Skinner addressed language *functions*, as early as 1957, in ways that would have significantly modified the Premacks’ discussions of lan-

guage. Certainly much of the recent work in behavior analysis is relevant to the authors' quest.

Discounting Imaging: Evidence from Different Sciences

Throughout the book one is told that "images" in the mind are necessary, that certain forms of imitation, not present in monkeys but present in humans, are made possible by *imaging* the behavior in our minds. Some brain scan research has shown that when monkeys do a behavior or see the same behavior done by others the same neurons "fire." This is not spurious evidence but the interpretation of this finding differs among scientists of various persuasions (Arbib, 2005). This is an interesting piece of information suggesting subsequent evolutionary paths leading to important brain structure modifications across species, especially verbal functions. However, to call these sorts of phenomena evidence of "mind" or the necessity of "imagining" is puzzling to me. Skinner's point about the naïveté of mental copies is as valid now as it was years ago (Skinner, 1987). Let me make an analogy.

Some years ago, one of my doctoral students, using electromyography, found that a muscle in the embouchures of professional trumpet players began moving before the players actually produced the pitch with their lips. This did not happen with beginning players. The movement was not an indication of an inherited capacity; rather, it was the behavior beneath the skin for the buzzing of the lips that produced the pitch or the consequence of the buzzing. It was learned. Moreover, the fact that this particular muscle had not been identified previously in applied physiology was likely a result of the lack of the utility that the muscle played beyond producing pitches on a brass instrument. Using operant procedures we could even shape the muscle to "fire" prior to buzzing with beginning trumpeters. Does this mean that this muscle movement is evidence of mind? Why can't the neuron firing in the monkey be described as a structural capability not unlike, say, the acoustic nerve, prehensile movement, or the jaw structure that evolved in humans that is distinctly different from the structure of the jaw of the Neanderthal? Apparently, even as neurophysiologists identify the motor activity of the brain, some psychologists who see the

need for psychological constructs must still treat the observed behavior as the product of a ghost in the machine. Certainly, without the evolved structure the neurons would not fire. Nevertheless, it is the consequences of the covert buzzing that was the source for the firing of the neurons, even when the behavior was beneath the skin, as was the case for our trumpeters. The construct of imaging as the source simply gets in the way. Rather than treating the behavior beneath the skin as just that, behavior, we are enjoined to give it the special status of a psychological construct. Ah, to paraphrase Skinner, to those who are not behavior selectionists, the skin still offers *special boundaries*, apparently even when the boundaries are broken by direct observation.

Cross Modal Transfer

Cross modal or *intermodal* transfer, as the Premacks term it, is important to some complex behavior of humans as well as other species. It is particularly important in certain verbal functions such as the recognition of sameness across different senses. It may be foundational to how the imitation of physical movement, seeing and doing, comes under the duplicitous frame or copying class of the very different echoic duplication leading to a higher-order duplicitous operant. (See Ross & Greer, 2003, for an environmental intervention that produced this cross-modal transfer). It is very likely that each of these modal capacities evolved separately and capriciously and came together in the human organism (Culotta & Hanson, 2004; Deacon, 1997; Holden, 2004). And it is possible, even probable, that cultural events created establishing operations that grouped these disparate capabilities into new relations with the environment—frames or higher order operants (Catania, 2001). When the separate listener and speaker repertoires came together it was possibly a result of certain cultural or conditioned establishing operations (Michael, 1982, 1984, 1993). The cultural selection worked because of behavioral selection that, perhaps, was even assisted by the close proximity of imitation, speech, and hearing activity areas in the brain, not unlike the special human jaw and the pharynx structure that made speech possible when cultural events selected out a use. Each of these selective systems is important in the evolution of

verbal function and other human capabilities—natural selection, behavioral selection, and cultural selection. Clearly, incorporating a thoroughgoing selectionist perspective would have added to the scope of *Original Intelligence*.

Synthesis: An Important Effort

I admire the Premacks' effort to synthesize evidence across disciplines; this is a noble and laudable scholarly effort. However, the omission of the science of behavior in their treatment is unfortunately limiting. Given the evidence that is accruing from verbal behavior analysis, it is simply no longer viable to omit verbal behavior analysis, behavioral biology, or certain kinds of evidence from the brain sciences (Butler, 2005) from a synthesis of language across the life sciences, particularly as the synthesis relates to verbal functions.

The Premack Principle is a basic component of behavior analysis and constitutes an important contribution to our field. He and his co-author are well-respected scientists in their field and the corpus of the authors' comparative and developmental work holds a prominent place in that literature. This book is an interesting read and would have been even more interesting if the behavior selectionist perspective had been incorporated. While I think the book will be of interest to colleagues in behavior analytic comparative psychology and behavior analytic developmental psychology, it is probably more interesting for those of us interested in a science of pedagogy.

Behavior Analysis and a Pedagogy and Curriculum for Complex Human Behavior

The book cuts to the chase about what might prove relevant to a comprehensive application of behavior analysis to education that can be gleaned from non-behavioral treatments of developmental and comparative psychology. If one overlooks the explanatory notions of the module theory and considers the actual capabilities that are identified there is much of interest. Indeed, the authors make a special case for the relevance of their research to pedagogy where they outline an incipient theory of education in their last chapter. However, unfortunately they state, "A theory of education could only be derived from understanding the mind that is to be educated" (p. 227). Because I find

the notion of mind not only problematical but seriously naïve, I was initially annoyed. Efforts to study a "theory of mind" require identification of behavior/environment relations. A reasonably sound science requires operational specification. (For a behavioral operational treatment of perspective taking see Barnes-Holmes, Barnes-Holmes, & Cullinan, 2001). I am not interested in behavioralizing construct psychology, although there is a body of work that has done so in a resounding fashion (Staats, 1981). But I am interested in finding testable ideas that might prove useful to a science of pedagogy, like the relational frame theory treatment of perspective taking, because a complete science of pedagogy is so closely bound to verbal behavior analysis. Verbal behavior analysis provides the necessary pedagogical research tools for identifying complex cognitive behavior such that the sources for, and functions of, the behavior can be investigated, and the findings from these investigations, in turn, can lead to protocols of effective pedagogy and curriculum design (Greer & Ross, in press). A verbal behavior perspective would have aided the Premacks' quest. So once I learned to ignore terms like "theory of mind" and identify the particular repertoires investigated, I found the book instructive in identifying possible repertoires and higher order operants to those of us interested in expanding a science of pedagogy and verbal behavior.

It seems increasingly clear that unless certain verbal capabilities, which I believe are higher order operants, can be induced in children who are missing them, the children cannot move ahead (Greer, Yuan & Gautreaux, 2005; Greer & Keohane, 2005; Greer & Yuan, 2003). We are beginning to be able to do so and in ways that are related to some of the capabilities that the Premacks identify. Thus, it is questionable whether the Premacks' expectancies are products of natural selection alone. Many of the expectancies that Premack and developmental psychologists propose are increasingly identified as higher order operants in verbal behavior analysis. Indeed, some behavioral biologists currently propose that certain linguistic functions are culturally selected.

Words as we know them co-evolved culturally with syntax through fractionation. In this view, many ways of expressing relationships that we now take for granted as part of language were the discovery of *Homo sapiens*;

for example, adjectives and the fractionation of nouns from verbs may be “post-biological” in origin. (Arbib, 2005, p. 108)

The building of capabilities as higher order operants is at the heart of much of contemporary verbal behavior analysis. Thus, while I was not convinced of the authors’ view of the origins of some of their expectancies, the identification of these capabilities was interesting because it suggested evidence of certain capabilities that are useful for those of us who are compelled to build a science of pedagogy from the behavioral foundations of complex human behavior. Skinner’s verbal behavior and recent extensions have made this feasible.

While I found the review of the research helpful in the latter pursuit, it became clear that much of the work in developmental psychology devoted to studying children, and indeed in our own science, suffers from a less than continual close contact with the participants’ repertoires and their evolution. In behavior analytic schools, behavior analyst teachers run scientifically based applications all day often for years with the same children. In some ways, D. Premack’s work with chimps involved such repeated contact, but necessarily with far fewer participants. Attempts to replicate some of the findings they cite call for more rigorous tests of histories of instruction, as do findings in the science of behavior. But unlike some developmental formulations, such as those of Piaget, there is something of a database here that is of interest, and this database suggests further tests in behavior analysis. In certain cases, it is clear that some of the inherited capabilities that non-behavioral developmentalists tie to age norms are missing in children with disabilities. Moreover, some work has now shown that when those capabilities or higher order operants (my take on expectancies) are missing, certain instructional experiences induce them. This does seem to call for revisiting the sources for these expectancies in typically developing children and maybe even chimps. Certainly, the work of the relational frame researchers (Hayes, Barnes-Holmes, & Roche, 2001) and recent verbal behavior analysis has provided a thoroughly behavioral approach to these heady topics.

Although, I would have liked more precise definitions of imitation, the authors’ treatment of the role of imitation is interesting, particularly the evidence they cite that humans, un-

like closely related species, look to the behavior they are teaching and specifically to insuring that behavior, really operants, is mastered. Thus while the chimpanzee will model the behavior for their young, they do not “evaluate” and consequate the behavior until mastered. Indeed, the various aspects of observational learning of which imitation is fundamental may also be distinct. Learning new operants or higher order operants by observing the consequences received by others is different from emitting a previously learned operant or a genetically programmed operant (See Greer, Singer-Dudek, & Gautreaux, in press, for research on the acquisition of certain types of observational learning). Knowing more about the differences in these repertoires would be useful indeed. While humans do evaluate and consequate in order to teach, years of teaching professionals to do this have convinced me that the real repertoires of pedagogy are learned and often require intensive teacher training, otherwise all children would be more advanced. The survival of the species will depend on advancing the pedagogical repertoire. Interestingly, Epstein, Lanza and Skinner (1980) simulated pigeons emitting teaching responses. Even though that capability may be uniquely human, cultural selection may have used that structural capability in humans, just as a special environmental design did so for the pigeons. It is unlikely that a teaching repertoire would have accrued without the cultural selection process. The Premacks’ theory of education will need to incorporate a much more sophisticated analysis of the cultural selection leading to the pedagogical repertoire.

Incorporating Behavior Analysis in the Mix

There are numerous points in the book that are enhanced by a familiarity with verbal behavior and behavior selection. In one such example the authors discuss the differences between human and related species in what appears to be a distinction between the tact and the mand. Using a match-to-sample paradigm for the mand does not appear to result in the tact repertoire for chimps, but these are also commonly independent for typically developing children at certain points in their verbal development as well as for children with developmental disabilities (Lamarre & Holland, 1985; Twyman, 1996). Since we have now

identified a means to transform mand and tact functions for a single form as a result of exemplar experiences with establishing operations (Nuzzolo-Gomez & Greer, 2004), we wonder if chimps could acquire such a transformation of establishing operation control. That is, there appear to be many findings in the pursuit of language research with primates that could be well informed by the work in verbal behavior. Certainly, this needs to be tested before the differences are identified as species specific.

Indeed, the book raised many such intriguing possibilities for comparative psychology. For example, children at certain stages, like chimps, see themselves in the mirror and touch the mirror, while children who are at an advanced stage touch themselves, hypothetically showing a *perspective-taking repertoire*. What if children or chimps, who could not do this, were taught to point to themselves and others seen in a mirror in multiple exemplar fashion would this result in perspective taking as it did for pigeons? (See Epstein, Lanza & Skinner, 1981.) Would the induction of perspective taking and other such capabilities, many of which may now be done, result in more advanced capabilities characterized by those who pursue a “theory of mind”? The answer to this question is important for pedagogical purposes, and such answers would in fact be a true test of many of the theses raised in the book. It is an interesting challenge for our science. Thus, what capabilities or higher order operants can be induced and what capabilities cannot, given adequate tests? This is a problem that is the basis of the difference between a behavioral and a non-behavioral developmental and pedagogical psychology (Bijou & Baer, 1978; Gewirtz, Baer, & Roth, 1958). Simple correlations between age and capabilities are just that, correlations, and that may be true as well of species differences.

I am reminded of a time when a colleague was doing chimp research and needed to hire behavior analysts from our program in applied behavior analysis because our students knew how to shape the behavior of children with deficits—deficits not unlike those of the chimp under study. That was 20 years ago and we knew little of the possibilities identified in recent verbal behavior analysis. I wonder what well-trained verbal behavior analysts could do with that chimp, given what we know now. Experience and age are closely related, but as

we know from work comparing impoverished and well to do children, or children with severe native disabilities, age is an empty variable (Hart & Risely, 1996). Experience is key, but it only becomes key when certain prerequisites are mastered. These prerequisites increasingly appear to be higher order operants or capabilities that, if not in place, interfere with the benefit of experiences. There is increasing evidence that there are ways to induce these higher order operants and following the induction of them, experiences that were previously not effective, become so.

A Comparative Psychology within a Species from a Science of Individual Variability

The benefit of comparisons between species is inestimable. However, the degree of variability within our own species, as the Premacks point out, is unique to humans. Behavior analysts have a long history of developing repertoires in children and adults with severe intellectual disabilities. We also have a growing corpus of work showing that those who don't have certain repertoires can acquire those repertoires under special instructional experiences. This work highlights the extraordinary capacity of the humans to learn complex repertoires from certain experiences (Greer & Keohane, 2005; Greer & Ross, 2004). Physiological structure is a limiting attribute, but structure too is malleable—experience modifies genetically programmed behavior (Dugatkin & Godin, 1992) and experience modifies brain structure and genes (Greenwald, 1997). We have just begun to test the malleability of structure. Nature and nurture are now inextricably reciprocal in biology (Robinson, 2004). Experience modifies genes and vice versa just as experience modifies genetically programmed behavior (Dugatkin & Godin, 1992). In fact, in their own conclusion chapter, the Premacks suggest that humans have a unique and historically unprecedented capability to educate the next generation. Leaving behavior analysis, behavioral biology (Butler, 2005), and basic work in the brain sciences (Greenwald, 1997) out of the mix will not identify how humans are to build a sophisticated pedagogy to educate the next generation. It is a task that behavior analysis is uniquely designed to accomplish—a task that developmental evidence

alone cannot do and a task that can benefit from a comprehensive synthesis of the evidence.

The authors set out to combine evidence from the life sciences to pursue what they characterize as original intelligence. Work in behavior analysis is critical to that effort. Personally, I don't want to omit any evidence that would be useful in building a more sophisticated verbal behavior analysis or science of pedagogy. We don't want to make the same mistake by omitting any evidence from the other life sciences that could be useful. A true fusion of the life sciences will not omit a science of behavior anymore than it would omit anthropological evidence, or any other relevant evidence from other sciences. The ultimate test is *does it work?* And in the pragmatic spirit that has driven the evolution of behaviorism, from the Scottish Enlightenment to American Pragmatism to Behavior Selection, the ultimate test remains *will it work* (Moxley, 2004)? We should leave no stone unturned in that pursuit. Sometimes you turn over a stone and there is nothing there, and sometimes there are possibilities. Possibilities that are testable may be useful. We should find out!

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